DOCUMENT RESUME

ED 200 770 CE 028 554

AUTHOR Epstein, Kenneth I.; Matlick, Richard K.
TITLE ISAS: The Instructional Systems Analysis and Selection Procedures. Part I: Models.
PUB DATE Apr 81
NOTE 24p.; Paper presented at the American Educational Research Association Annual Meeting (Los Angeles, CA, April 13-17, 1981).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Educational Research; *Evaluation Methods; *Instructional Design; Instructional Innovation; *Instructional Systems; *Job Training; Material Development; *Media Selection; *Models; Postsecondary Education; Systems Approach; Teaching Models
IDENTIFIERS *Instructional Systems Analysis and Selection; Litton Industries

ABSTRACT

Litton Industries has been investigating methods for analyzing training problems and designing appropriate systems of individualized instruction to address those problems. This work can be referred to as the development of the Instructional Systems Analysis and Selection (ISAS) procedures. ISAS is a collection of questions, comparison matrices, guidelines, and suggestions designed to assist in the analysis of an instructional or training problem. The objectives of the analysis are to choose an instructional systems model that best fits the training need and to develop the highest quality and most cost-effective instructional materials possible within that model. An instructional model is a description of the overall system for delivering instruction. It describes the flow of trainees through the system, indicates the important decision points, and makes it possible to predict how the system will behave under different conditions. Several possible models are proposed and discussed in this paper. (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED200770

ISAS: The Instructional Systems Analysis and Selection Procedures Part I: Models

Kenneth I. Epstein
Gallaudet College

Richard K. Matlick
Litton Mellonics

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Kenneth Epstein

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

A paper presented at the annual meeting of the American Educational Research Association, Los Angeles, California, April, 1981.

CE 028 554

ISAS: The Instructional Systems Analysis and Selection Procedures Part I: Models

Kenneth I. Epstein
Gallaudet College

Richard K. Matlick
Litton Mellonics

Litton Mellonics Systems Development Division has recently completed a project with the Army Research Institute for the Behavioral and Social Sciences which explored alternative models for individualizing Armor training (Matlick and Epstein, 1980). Considering the importance of individualized instruction and systematically designed instruction, we were able to find only relatively few examples of successfully implemented programs. There are probably as many reasons for this state of affairs as there are people who have tried to make instructional systems work, but it was possible to identify a limited number of problems that seemed to be common to most attempts. One of these common problems is that it is difficult to specify the factors that need to be considered in planning and designing an instructional system. A second involves matching an instructional system with the training needs and institutional environment in which it is to be implemented. Third, effective individualized training programs often involve self-pacing, multiple instructional methods, and a requirement for flexible training management. In order for such systems to operate, there must be strong support from training managers and flexibility in the personnel systems that interact with the training by providing new trainees and absorbing graduates. The ARI project resulted in recommendations which suggested that a broad view of subject matter, instructional environments, and instructional systems is necessary to address these problems. It also laid the groundwork for a set of procedures to permit such an approach to be implemented in a systematic fashion. Since the completion of the ARI project, Litton has continued to investigate methods for analyzing training problems and designing appropriate systems of individualized instruction to address those problems. We are currently referring to this work as the development of the Instructional Systems Analysis and Selection (ISAS) procedures.

ISAS is a collection of questions, comparison matrices, guidelines, and suggestions designed to assist in the analysis of an instructional or training problem. The objectives of the analysis are to choose an instructional systems model that best fits the training need and to develop the highest quality and most cost-effective instructional materials possible within that model. ISAS interacts with five major

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington, VA 22202 (703) 920-8822

components of training: the identified need, the Instructional Systems Development (ISD) procedures, the environment in which the training will take place, the management system that controls the training, and a selection of instructional systems models that reflects the state-of-the-art according to both theory and practical experience. The ISAS procedures themselves deal with three aspects of the training system: context, controlling factors, and models.

The context of instruction is defined as the total environment of any given instructional undertaking. It consists of three dimensions: time, setting, and focus. Each dimension includes several categories.

Time may be either fixed or variable. When time is fixed, all trainees must be in the training program for the same fixed amount of time, regardless of their particular needs or abilities. A variable time context permits the training time to vary for different trainees with different needs or objectives.

Setting refers to the training environment. It may be operational, instructional outdoor, instructional indoor, or independent. An operational setting describes a training system that is embedded in a real or simulated operational environment. An instructional outdoor setting is one which makes use of facilities which have been designed, or at least designated, specifically as training areas. An instructional indoor setting is a classroom or other facility used for training. Finally, an independent setting is one in which individuals are free to learn on their own. Thus, the independent setting refers more to materials and teaching philosophy than to a physical location. An independent setting could be observed in an operational environment, indoors, or outdoors. It is included as a separate setting because of its usefulness conceptually in analyzing and designing instructional systems.

Focus refers to the content of the training program. It consists of three categories: equipment, technique, and knowledge. A focus on equipment identifies training concerned with the nomenclature, maintenance, principles, functions, and operation of equipment. It is concerned with equipment per se, not with what the equipment is used for. A focus on technique refers to how personnel interact with the equipment. It is concerned with the methods, processes, and skills necessary to permit the equipment to serve the purposes for which it was designed. Technique is the "man" in man-machine systems. A focus on knowledge refers to the acquisition of knowledge. Knowledge can be theory or background information concerning a new skill for the

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

trainee, it can refer to information that may be only peripheral to the actual task that must be learned, or it may refer to those tasks which are purely cognitive in nature.

Eight controlling factors which define the characteristics of specific training programs are considered by ISAS. The factors are (1) how the available time is allocated in a particular training program, (2) instructional personnel, (3) facilities, (4)instructional management, (5) student population characteristics, (6) course content, (7) instructional methods, and (8) media, materials, and devices. Factors may be constraints placed on training, they may represent options, or they may dictate certain decisions. Existing values of the factors can be used in analyzing an existing training system, or, using past experience and theory, the values that the factors would be likely to take given certain design decisions can be estimated to guide the development of new training systems.

The third aspect of training considered by ISAS is the choice of an instructional model. An instructional model is a description of the overall system for delivering instruction. It describes the flow of trainees through the system, indicates the important decision points, and makes it possible to predict how the system will behave under different conditions. This paper is concerned with models as they are currently viewed by ISAS. Future papers will discuss context, controlling factors, and how it all fits together.

We have chosen to begin with models for two reasons. First, the choice of an appropriate instructional system model is one of the primary goals of the procedures. Second, we have taken what we think is an unusual approach to describing instructional systems models, and we want to present it early to try to avoid misunderstandings as we tie models to the other aspects of the ISAS procedures.

First, some background. Litton completed a fairly extensive review of the literature pertaining to individualized instruction and generic instructional systems models last year (Matlick, Swezey, and Epstein, 1980). One of the conclusions of that review was that there are relatively few differences between models that can't be classified as idiosyncratic twists to a small group of general principles. The twists are usually designed to meet specific local conditions. For example, different models may present different variations on the theme of "recycling if students don't meet minimum standards," but they are all models which contain feedback loops. The review proposed a four-dimensional description of instructional systems models, with each description having two levels. The four dimensions are time,

Litton MELLONICS
Washington Scientific Support Office
Suite 506 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

objectives, proficiency, and treatment, and all can be either fixed or variable (Figure 1). The review also includes several examples of systems of individualized instruction and shows where they fit within the 16 models defined by the four-dimensional scheme.

Dealing with 16 generic models instead of some very large number of specific models made it considerably more easy to think about ISAS, but the four-dimensional matrix still seemed cumbersome. Therefore, we've tried to simplify. We have defined three general classes of instructional systems models. The three classes differ with respect to student performance data. Post-instruction student performance data are not collected as part of the class 1 models. The class 2 models call for the collection of post-instruction student performance data, but the data are not used to influence the instruction a student receives. The class 3 models use post-instruction student performance data to make instructional decisions about each student. Diagrams of the basic models which describe each class are in Figure 2.

We have tried to draw the model diagrams as simply as possible. In general, one follows the diagrams from START to END without backtracking. By following a diagram from left to right, one can trace one or more paths that a student could follow through an instructional system. Branches represent choice points. Movement is always from left to right with Class 1 and Class 2 models. However, in the case of the Class 3 models a decision to recycle and move back toward the left and to some earlier part of the system is possible.

In addition to the basic model in each class, we have described three types of elaborations: pretests, choosing objectives, and choosing treatments. Our intent is not to exhaustively list all of the possible varieties of instructional systems within each class. Rather, we have tried to describe the most common examples of instructional systems in general model terms so that the 24 systems diagrams (Figures 3-5) which elaborate each class of model will accommodate most applications. We hope that when ISAS is complete the procedures will guide an instructional developer to one or several of the models that are most appropriate for his or her application. The specific refinements that are necessary to fit a particular application can then be made relatively easily.

Once the differences among the basic models in each class and the effects of the 3 types of elaborations are understood, there is much more in common among the individual models than there are differences. Therefore, we will restrict detailed discussions to each basic model and to each

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy. Arlington VA 22202 (703) 920-8822

elaboration as it applies to class 1. Explanations of more complex combinations of models and elaborations will not be offered in most cases.

Class 1 Models

The class 1 models are diagrammed in Figure 3. The basic model, which we will label model 1, has 3 components: start, instruct, and end. Students enter the instructional system, instruction is presented, and they leave when the instruction is finished. There is no testing to determine whether any student has learned anything. Class 1 models are appropriate when the goal of the instructional program is exposure. The criterion for judging students is whether or not they attend. All students who complete the instructional program are treated equally. Examples of instructional programs which could be included in class 1 are job performance aids, non-formal on-the-job training, most self-initiated learning, and any of a wide variety of programs which have as their primary purpose providing information.

The apparent simplicity of model 1 and its lack of formal student performance evaluation should not be interpreted as implying that this model is unimportant or easy to implement. In fact, the case is quite the contrary. Because there is no student testing, the initial instructional design must be so well done that the user can feel confident that the message will be received by the learners. In addition, many applications of model 1 are likely to be in non-formal educational settings. For example, a booklet describing measures to take in case of accidental poisoning is described by this model. The booklet has a clear instructional intent, the learner begins the instruction on his or her own, receives the instruction by reading the booklet, and finishes the instruction when the booklet is finished. The booklet must be designed well enough to insure that the instructional message will be received by a wide variety of users in many different settings. Examples of class 1 instruction in more formal settings are introductory lectures to programs or formal stand-alone lectures that one attends for information and enjoyment. This paper is an example of class 1 instruction. We hope it transmits a useful message successfully.

We have chosen 3 types of elaborations which could be used to improve the fit of model 1 to specific situations. Whether or not these, or other, elaborations are worth the additional development or management costs will depend on each application. We do feel that one could argue for any of them given appropriate conditions. The elaborations are: pretest, choose objectives, and choose treatment.

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy. Arlington VA 22202 (703) 920-8822

The combination of model 1 and a pretest (model 1.P) is one way to accommodate individual differences among students. The term "pretest" is used here very loosely to mean any collection of data which is used to make a decision about a student before the instruction starts. Thus, pretests could measure prior experience, background variables, specific skills, desires, or anything that could lead to a decision to exempt or eliminate a student from the instruction.

Elimination implies that receiving the instruction would not be worthwhile because the individual does not have the necessary background or prerequisite skills. For example, it would be a waste of time to attend a technical lecture on high energy quantum physics if one had never studied any science beyond junior high school general science. Elimination criteria will probably be based on specific skills or experience that the prospective student needs to benefit from the instruction. The criteria will often be generated by those responsible for the instruction, but they could be determined by the individual learner. Similarly, the decision to eliminate could be made by the individual, or it could be imposed by the deliverer. Elimination should be considered equivalent to non-attendence in any subsequent actions. An important management problem, particularly in a formal instructional setting, is deciding what to do with those individuals who are eliminated.

Exemption implies that receiving the instruction would not be worthwhile because the individual already knows the information to be presented. While a pretest based on skills could be used to determine whether or not the skills had been acquired, there is a potential contradiction. That is, mere exposure to the instruction is all that is required of most students. Therefore, prior exposure should be all that is required for exemption. One possible solution would be to consider satisfactory performance on the elimination portion of the pretest a requirement for consideration for exemption. In other words, elimination criteria have precedence over exemption criteria. In any case, while elimination is considered equivalent to non-attendence, exemption should be considered equivalent to attendance in any subsequent actions. For example, individuals could be exempted from a normally required "orientation to the school" lecture if they are continuing students who have attended the lecture in the past 2 years. Exemption also leads to the problem of what to do with the students who do not take the instruction.

The combination of model 1 and choosing different objectives for different students (Model 1.Ob) recognizes that in many applications it is not important for everyone to learn about everything. An example of model 1.Ob is a career counseling center that offers several booklets on careers,

Suite 500 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

each on a different topic. The students are expected to read one or more of the booklets, but, for the most part, no one is expected to read all of the booklets and each student is free to select the topics of greatest personal interest.

Several conditions must hold for model 1.Ob to make sense. First, it must be reasonable to deal with individual objectives or clusters of objectives. For many applications it may be better to consider all of the instructional objectives as a single unit. In such cases, students will be exposed to all or none of the objectives, and model 1.Ob will not be a reasonable option. Second, there should be some reason to expect that students will want to choose among the possible objectives or collections of objectives. Third, there must be resources available to develop the program and a management system flexible enough to accommodate varying choices of objectives.

The statements "choose objectives" and "instruct" in the diagram hide what could be very complex operations. The process of choosing objectives could be done by the individual student, or it could be based on a set of formal procedures and specific criteria. Once a collection of objectives had been chosen, a variety of instructional packages would have to be available to meet the different student demands. Particularly in a formal setting this model may be too cumbersome to be worthwhile, although a more open setting such as a counseling center might be an excellent environment for its application.

A variety of instructional treatments could be added to model 1 (model 1.T). This model recognizes that different instructional modes and media are more or less appropriate for different learners. Thus, the same content could be presented in booklet form, through some type of audiovisual device, or by individual interaction with students. This model, much the same as model 1.Ob, may have its most useful applications in non-formal learning environments where the students are given the choice of instructional treatment. Applications in more formal settings, using pre-set criteria for choosing the treatment, are also possible.

Providing a variety of instructional treatments is very demanding of both development and management resources. Instructional development costs will increase as the number of delivery modes increases, and a solid theoretical base for matching students with different characteristics to their most appropriate instructional treatments does not now exist. Management flexibility and careful planning will be necessary to insure that student flow through the system is smooth. An additional concern common to both this model and model 1.Ob is that different treatments and clusters of objectives are

likely to take different amounts of instructional time. Plans must be made to permit students to leave the system at different times.

The other models in class 1 are more complex combinations of pretest, choose objectives, choose treatment, and the basic model. In each of the combinations we have shown the choice of objectives coming first, the pretest second, and the choice of treatment third, followed by the instruction. The reason for this ordering is that it seemed that any pretesting should only be concerned with the objectives that were of interest, and that it was premature to choose a treatment before exemption or elimination decisions were made.

Detailed explanations of the possibilities and implications of these other class 1 models are beyond the scope of this discussion, but we will suggest one example. One way to visualize the most complex of the models (1.Ob.P.T) is to think of how most people use a library. The objectives offered by the library are defined by the scope of the collection. The instructional treatments include a number of print formats, audiovisual materials, and resource people. Users must decide, on the basis of their own experience and skills, how they can best take advantage of the instructional modes available and which options must be eliminated. Once individuals have chosen a set of objectives and treatments, they begin the instruction and continue until they feel that they are finished. There is no testing, but the use of the library is usually acknowledged and learning is usually assumed.

Class 1 models are characterized by their emphasis on providing information and their lack of formal post-instructional testing. Completion of class 1 instruction should not carry with it any certification beyond attendance or the fact that the instruction was completed. In particular, it does not imply that skills have necessarily been learned. While carefully developed instruction will improve the chances that skills are learned, completion of class 1 instruction does not insure it for any individual.

Class 2 Models

The difference between the class 1 and the class 2 models is the addition of student post-instruction assessment in the class 2 models (Figure 4). This seemingly small difference represents a fundamental difference in focus. Class 1 instruction is concerned with exposure. Class 2 shifts the focus to what is learned. The results of receiving the instruction are quantified and made public. This affects both the student and the delivery system.

For the student, the addition of testing may be motivating, it may be anxiety producing, it may reinforce important points, or it may confuse. In any case, it means that there will be some more or less quantitative measure of performance which stays with the student. Subsequent instructional or career decisions will probably depend to some extent on the results of the measurement.

For the instructional system, the addition of assessment means that tests must be written, that time and personnel must be made available to administer the tests and score the results, and that the results must be recorded. The existence of student performance data also means that the system itself can be evaluated in terms of what the students learn. The class 2 models do not use any particular student's performance data to control or modify the instruction that that student receives. Whether the data are used to modify the instruction for future students is left an open question.

The basic class 2 model, model 2, describes most traditional education. Students enter the system, they receive some instruction, they are tested, and they leave. At the level of individual courses, the testing has relatively little importance for most students. Unless the test results are exceptionally good or poor, they do not make much difference in subsequent decisions.

Model 2 can also describe training environments in which the results of testing can be very meaningful and important. For example, the assessment following training could serve as a certification test. Satisfactory performance on the test might be a requirement for beginning a job. Particularly with the courts getting more involved with certification, the assessment portion of class 2 models can be very important.

The addition of a pretest, represented by model 2.P, creates the same kind of effect as it does for the class 1 models. Pretesting permits students to exempt the instruction if it is not necessary, and it permits the elimination of students who are not adequately prepared for the instruction. The difference in a class 2 pretest is its relationship to the posttest. Since students' posttest scores may be used in subsequent decision making, those who do not receive the instruction need comparable data. Therefore, pretests will probably need two components. The first will deal with the minimum criteria for beginning instruction. Class 2 minimum criteria will probably be very similar to those for class 1 and could include such data as prior experience or prerequisite skills. For those students who did not meet the minimum requirements, no further testing would be necessary. They would not be permitted to begin the

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy. Arlington VA 22202 (703) 920 8822

instruction and some other arrangements would have to be made. Students who met the minimum criteria and wanted to exempt the instruction would move on to the second component of the pretest. The second component would produce a score comparable to the posttest score. Students choosing to exempt the instruction would be treated, for subsequent decisions, as though they had completed the course and had obtained the posttest results equivalent to their pretest results.

Model 2.Ob, which represents the addition of a choice of objectives, and model 2.T, the addition of multiple treatments, are directly analagous to their class 1 counterparts. Different students could receive instruction and be tested on different objectives. A variety of instructional treatments could be offered using either common posttests or posttests that are equivalent in content but that match the modes of their respective treatments. There does not appear to be any sort of interaction between the choice of objectives or treatments and the existence of posttests.

The class 2 models may be most useful in describing and analyzing most of the instruction in use today. The basic model describes instruction at the course or unit levels. The class 2 elaborated models offer reasonably good descriptions at higher levels. For example, the way that students enter higher education seems to fit model 2.Ob.P relatively well; students choose objectives by choosing majors, some students are eliminated and some are able to exempt courses, and all students take posttests. Model 2.Ob.T describes the type of system which presents some students a precollege high school curriculum while others get more job-oriented vocational training.

The existence of student performance data that are used outside the instructional system itself is the distinguishing characteristic of the class 2 models. These data may be used to make decisions about the student or about the instruction or both. Class 2 models appear to describe most instruction and training now in operation.

Class 3 Models

The class 3 models (Figure 5) include the cybernetic instructional systems. The diagrams differ from those of class 1 and class 2 in the addition of an evaluation step and a feedback loop. Evaluation consists of interpreting the results of each student's assessment and deciding whether the student has performed at a high enough level to permit him or her to exit the system. If satisfactory performance is not achieved, the student remains in the system for more instruction.

Litton MELLONICS Washington Scientific Support Office
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington, VA 22202 (703) 920-8822

This class of models represents a fundamental difference in philosophy. In the first two classes, the burden is on the student to get what he or she can from the system. Once pre-instructional decisions are made, the system will not change to meet the demands of each individual student, and the student only has one try at learning the content. In the case of class 3, the burden is shifted to the instructional system. The student does not leave the system until acceptable results are obtained.

The variety that is possible within the general models included in class 3 is tremendous. Most of what is known as individualized instruction, in its many forms, is defined by the class 3 models. In fact, model 3 and model 3.P, which adds a pretest, probably account for the majority of individualized instruction systems. We will now consider some of the general characteristics of the class 3 models.

The different class 3 models illustrate a variety of general strategies for achieving the goal of insuring that students reach minimum performance standards before they leave the instructional system. The basic model, model 3, uses time. If the results of a student's pretest indicate that more learning is necessary, he or she is returned to the instruction to try again. While continued instruction may help the student reach the desired level of performance, this is not an efficient and, probably, not a very effective model. An extreme example of this model is the practice of repeating a grade in the public schools. Those students who perform so poorly that they are not promoted in the public schools probably have severe enough problems to warrant more extreme measures than simply repeating a grade.

The addition of a choice of instructional treatments to the basic model results in a much better model, Model 3.T. Even if the choice of treatments is limited to remedial units or short segments of instruction geared to difficult content areas, in addition to the regular program, the second period of instructional time can be used more efficiently and effectively than if the original instruction were simply repeated. If more treatmments representing different media and instructional strategies could be made available, greater effectiveness and efficiency could be expected. Notice that the diagrams for the models employing a variety of treatments indicate the possibility of <u>not</u> choosing a new treatment. Simple recycling through the instruction is included because it is possible and because it may be necessary in some cases. However, our general feeling is that it is not the best method to choose. We also feel that the multiple treatment elaboration should be employed for all class 3 models if at all possible, regardless of whether or not other elaborations are included.

Model 3.T may also offer a method for gaining flexibility with respect to time. It may be that by choosing the appropriate instructional treatments the amount of time necessary for different learners to reach the same level of performance could be made more equal. For example, a student with reading difficulties would probably need more time to reach criterion than an excellent reader if the only instructional treatment was one that used a traditional textbook. On the other hand, the excellent reader might get bored and bogged down with a programmed text while the poorer reader did fine. If each student were matched with the most appropriate medium, all might be expected to reach criterion in about the same amount of time. We need to learn much more about matching learners with instructional treatments before any sort of strong recommendations can be made in this area, but this approach appears to offer some interesting possibilities.

Model 3.Ob, which results from the addition of a choice of objectives to the basic model, may offer another way to gain flexibility. This model is appropriate for situations in which different combinations of objectives are appropriate for different students, or in which a common set of basic objectives is required for all students with additional optional objectives available for students with greater interest or ability. Imagine, for example, an environment where the total instructional time is fixed, like a ten week training program in a school, but where the requirement for minimum performance standards also exists. It may be possible to identify a set of critical objectives that normally requires about five weeks of training. This leaves open the possibility of recycling through the course if necessary. For those students who complete the course in five weeks, additional instruction for objectives of the "useful but not critical" type would be made available. The addition of remedial instruction or other instructional treatments, as defined by model 3.Ob.T, would increase flexibility. Another possibility included in the model diagrams is the reconsideration of the objectives to be included in the instruction as part of the feedback loop. This would permit a student to receive only the instruction for the objectives not successfully met or to restructure a program in light of what was and was not learned and the time still available. If the option to reconsider objectives is taken, one must be cautious not to permit those objectives that are absolutely required to be dropped.

Pretesting for class 3 models serves the same purpose as it does for the class 1 and class 2 models. In most cases it will not be part of the feedback and recycling process. In those cases where it could be, model 3.Ob.P and model 3.Ob.P.T, its use will be in conjunction with choosing objec-

Litton MELLONICS Washington Scientific Support Office
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

tives. The important difference in pretesting with class 3 models is that exemption criteria must be equivalent to criteria for successful completion of the instruction. In other words, students should not be permitted to exempt the instruction unless they can meet the minimum standards.

An additional method for achieving flexibility with the class 3 models is the provision of variable minimum standards. The logic is that different students have different needs and, therefore, require different levels of proficiency for any given skill. Variable standards also apply to objectives. Certain objectives will represent more critical skills than others. The minimum standards should, therefore, reflect the relative importance of the objectives. Clearly, great care must be taken in varying minimum standards to insure that requirements are not permitted to fall too low to be meaningful.

The unique characteristic of class 3 instructional systems models is that the responsibility for helping students reach minimum standards of performance rests on the system itself. The basic method used to achieve this goal consists of an end-of-instruction evaluation of student performance followed by continued or repeated instruction, if necessary. Through the use of flexible scheduling, pretests, multiple instructional treatments, and various mixes of objectives, the basic class 3 model can be refined and made applicable to a wide variety of situations. The important point is that all students who successfully complete instruction that is described by a class 3 model can be expected to perform at or above some well defined criterion level.

The purpose of defining instructional systems as we have is to increase the likelihood that newly developed instruction will fit the environment in which it is to be used. The precise tailoring of instruction to needs and environments will increase the likelihood that the instruction will be cost-effective, that it will remain in use, and that it will help students achieve the instructional objectives. Furthermore, ISAS could result in greatly reduced development costs by making it easier to broadly distribute instructional materials. This could come about because the ISAS procedures define the general characteristics underlying any particular instructional system. Thus, decisions to adopt or adapt materials would be simplified. In cases where adaptation was necessary, the ISAS procedures would provide a natural guide for making revisions.

Regardless of the application, a method for choosing a model is needed. We see the choice of a model consisting of three steps. First, one must decide whether a class 1, class 2, or class 3 model will be used. Given a class, the ela-

Litton MELLONICS
Washington Science Support Office
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington, VA 22202 (703) 920-8822

borations to implement are chosen. Third, the model's implications for development time, cost, and personnel, and the model's probable interactions with and demands on the environment must be considered. If the model appears feasible, then development may begin. If not, then an alternative model must be chosen. We expect that the process of choosing a model will lead to better definitions of instructional needs and the environment than is often the case. We also expect that the definition and choice process will be iterative. As the implications of choosing certain models become more clear, it may become necessary to modify the overall goals of the instruction, the environmental constraints, or both in order to achieve reasonable results.

Figure 6 summarizes some of the important points that will have to be considered in choosing a model. They are shown as cells of a matrix rather than as nodes in a decision tree because a set of yes/no decisions that can be used in a deterministic manner to choose one and only one model does not exist. Rather, by considering the array shown in Figure 6, reasonable alternatives can be identified for consideration in the final selection process.

ISAS is an evolving set of ideas. We are in the process of refining our thoughts on the other two aspects of the training system that ISAS is most concerned with so that the procedures dealing with contexts and controlling factors will fit the ideas about models described in this paper. As the implications for model selection of contexts and controlling factors become better defined, the general ideas described in Figure 6 will also become more specific. We are also trying to develop specific procedures to guide a relatively naive user through ISAS. Finally, we are looking for opportunities to put ISAS to work. The greatest weakness with ISAS is that it is only a collection of ideas which appear to work when applied, post-hoc, to an existing system. What we need now is a situation where the ISAS ideas can be applied early in the instructional development process to determine if they can, in fact, lead to a better match between the instruction and the need.

Matlick, R.K., Swezey, R.W., and Epstein, K.I. Alternative models for individualized Armor training, Part I, Interim report: Review and analysis of the literature. Alexandria, Va.: US Army Research Institute for the Behavioral and Social Sciences, Research, Note 80-1, 1980.

Matlick, R.K. and Epstein, K.I. Alternative models for individualized Armor training: Final report. Arlington, Va.: Litton Mellonics Systems Development Division, 1980.

Litton MELLONICS
Washington Scientific Support Office
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington, VA 22202 (703) 920-8822

			TREATMENT			
			FIXED		VARIABLE	
			PROFICIENCY		PROFICIENCY	
			FIXED	VARIABLE	FIXED	VARIABLE
TIME: FIXED	OBJECTIVES: FIXED		1	2	3	4
	OBJECTIVES: VARIABLE		5	6	7	8
TIME: VARIABLE	OBJECTIVES: FIXED		9	10	11	12
	OBJECTIVES: VARIABLE		13	14	15	16

Figure 1: Classification of Models of Individualized Instruction (adapted from Matlick, Swezey, and Epstein, 1980, p.86)

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington, VA 22202 (703) 920 8822

Litton MELLONICS

Model 1

Model 2

Model 3

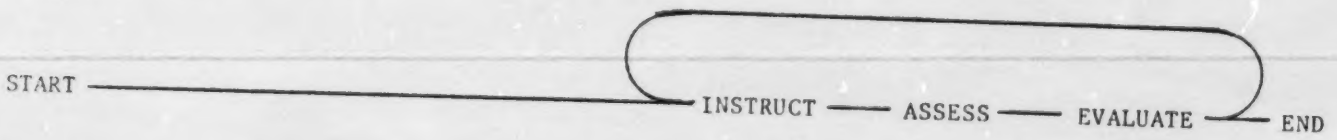
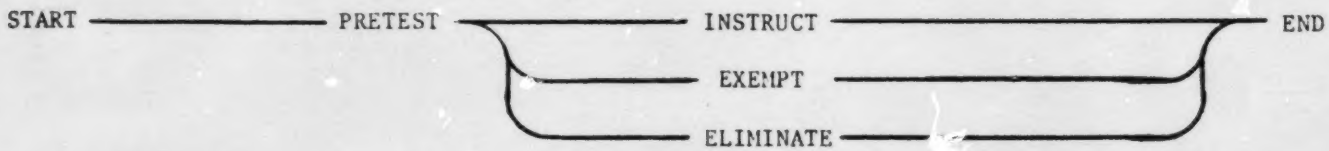


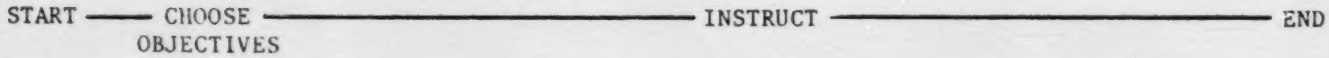
Figure 2: Basic Instructional Systems Models

Model 1

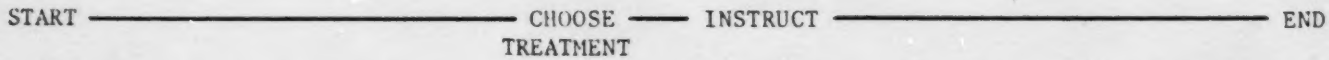
Model 1.P



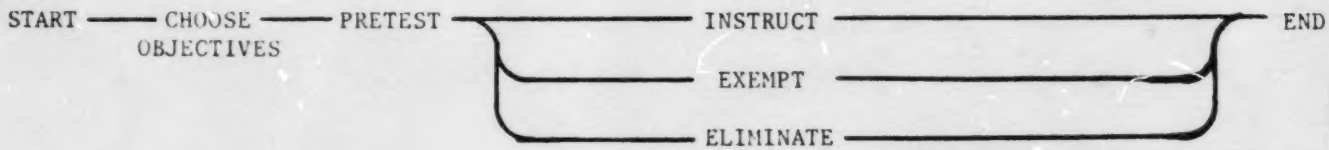
Model 1.Ob



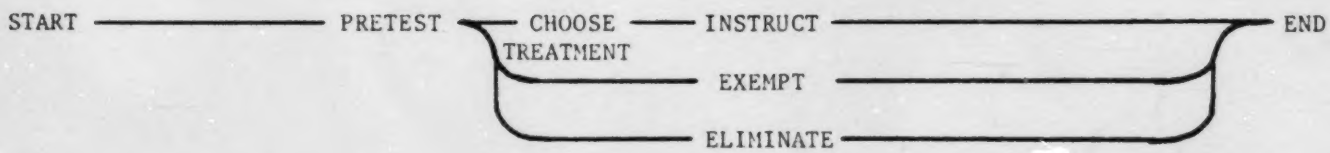
Model 1.f



Model 1.Ob.P



Model 1.P.T



Model 1.Ob.T

Model 1.Ob.P.T

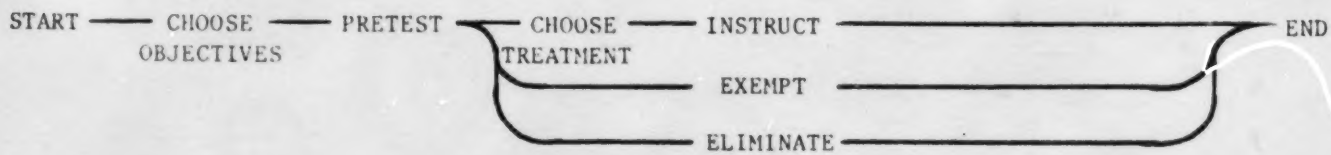
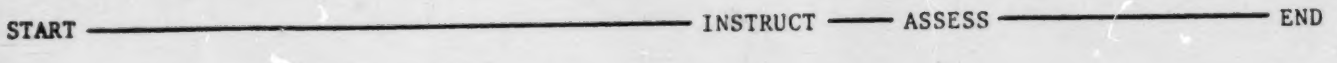


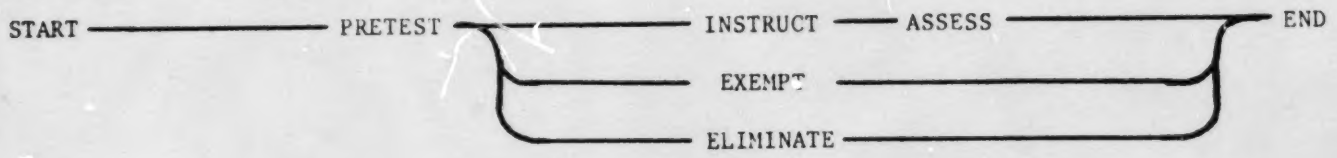
Figure 3: Class 1 Models

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

Model 2



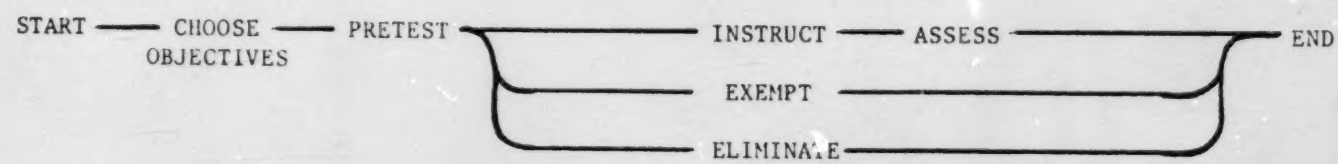
Model 2.P



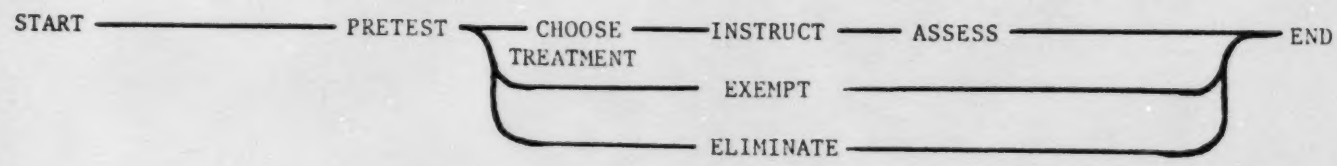
Model 2.Ob

Model 2.T

Model 2.Ob.P



Model 2.P.T



Model 2.Ob.T

Model 2.Ob.P.T

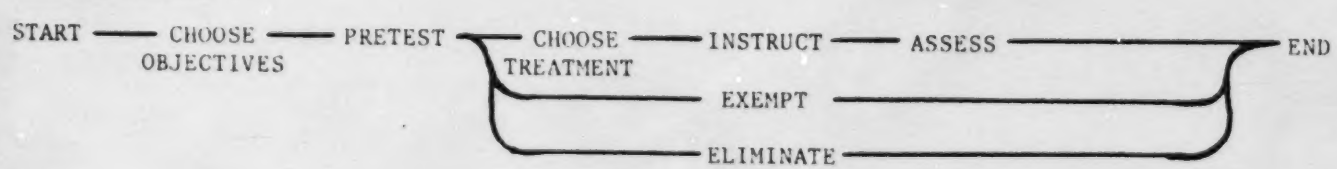


Figure 4: Class 2 Models

Litton MELLONICS
Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

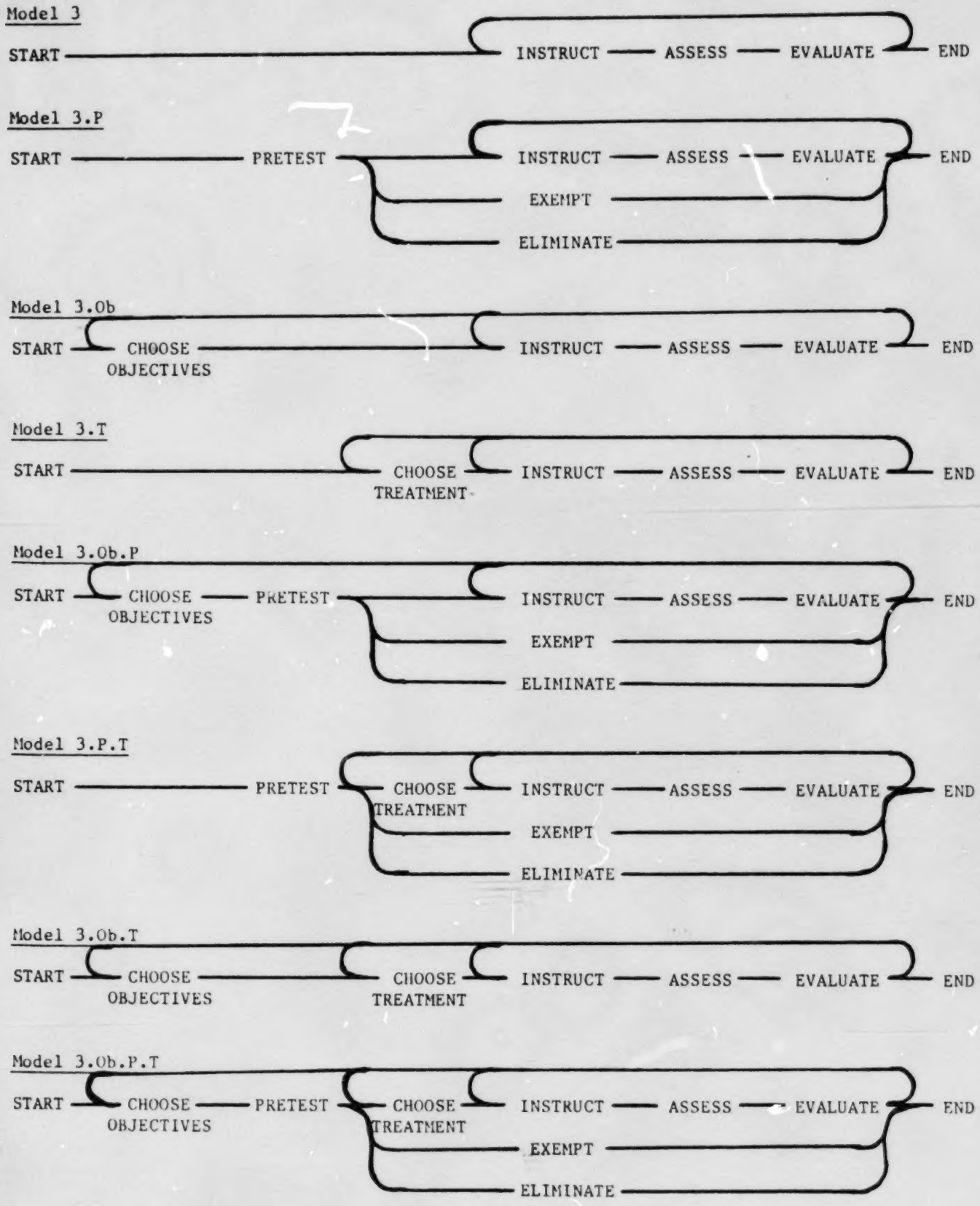


Figure 5: Class 3 Models

Suite 508 Crystal Square Two 1725 Jefferson Davis Hwy Arlington VA 22202 (703) 920-8822

	BASIC MODEL	PRETEST	CHOOSE OBJECTIVES	CHOOSE TREATMENTS
CLASS 1	Exposure to information No report of student performance	Development/ administration/ scoring costs False positive and false negative errors Accommodate students who do not receive instruction Increased efficiency and throughput Better student attitudes	Development/delivery costs for multiple groups of objectives Development/administration costs for procedures to choose objectives May imply variable time Increased efficiency Better student attitudes	Development/facilities/ staff for different treatments Costs of misassignments Development/administration costs for assignment methods May imply variable time Increased efficiency Better student attitudes
CLASS 2	Final student performance reported Individual performance does not effect system	Same as Class 1 <u>except</u> Postests decrease pretest development/ administration/ scoring costs	Same as Class 1 <u>except</u> Posttests keyed to objectives Score reporting system keyed to objectives	Same as Class 1 <u>except</u> May imply different posttests to match different treatments
CLASS 3	Minimum standards required Cybernetic systems	Same as class 2 <u>except</u> Possible variable standards	Same as class 2 <u>except</u> Possible variable standards Increased time flexibility	Same as class 2 <u>except</u> Highly recommended: remedial treatment almost mandatory

Figure 6: Considerations in Choosing a Model